Bedrock Geologic Map of the West Liberty 7.5' Quadrangle, Muscatine, Cedar, and Johnson Counties, Iowa

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Open File Map: **OFM-25-4**
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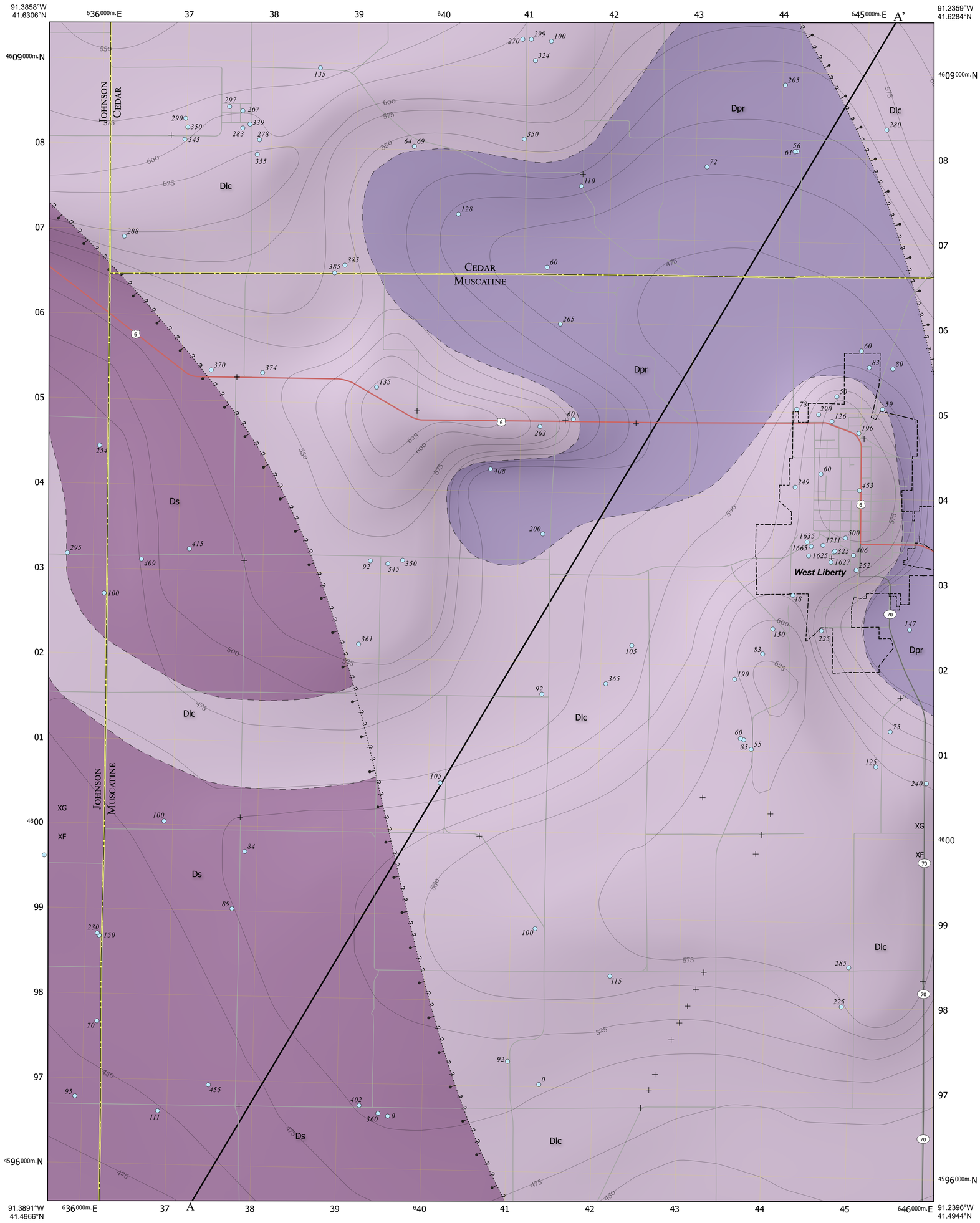
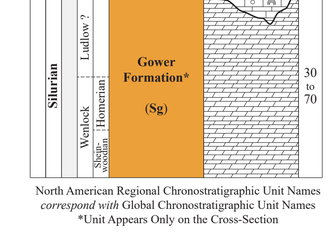


Introduction

The West Liberty 7.5' Quadrangle in Muscatine, Cedar, and Johnson counties, Iowa, is located within the Southern Iowa Drift Plain (SIDP) and Iowa-Cedar Lowland (ICL) landform regions. There are no bedrock exposures in the map area due to burial by Quaternary materials. The SIDP is an area with surface topography defined by loess-mantled uplands and slopes, whereas the ICL is a low-relief floodplain consisting of sediment deposited by the Cedar River. The top of the till package of the SIDP in the map area is likely Pre-Illinoian-age diamicton of the Wolf Creek/Alburnett formations. The ICL is a broad, flat lowland that is comprised of outwash deposited during the Late Wisconsin Episode and the Cedar River has formed Holocene terraces in this valley. The shape of the ICL does not directly correspond with the underlying bedrock channel (Cleona Channel).

The Cleona Channel is a buried bedrock valley that trends northeast – southwest across Muscatine County, and this channel can be up to 350 feet deep below the modern land surface. However, the primary channel of this buried bedrock valley is just south of the map area. Although entirely buried by Quaternary deposits, the bedrock surface of the West Liberty 7.5' Quadrangle is dominated by Upper Devonian (Frasnian) strata of the Sweetland Creek Formation, as well as Middle Devonian (Givetian) strata of the Little Cedar Formation (Cedar Valley Group) and the Pinicon Ridge Formation (Wapsipinicon Group). Just to the east of the mapping area these Paleozoic stratigraphic units are exposed in the Moscow Quarry (Wendling Quarries Inc., in the Wilton 7.5' Quadrangle; IGS Open File Maps OFM-24-01 and OFM-24-02). Due to sparse well data and the lack of bedrock exposures within the quadrangle, the contacts between these stratigraphic units are concealed and have been dashed on the map. It is quite likely that there are numerous faults within the bedrock succession of Muscatine County – Devonian (and underlying) strata are offset between 20 to 100 feet in elevation between nearby wells. However, these faults are completely concealed, and their locations have been inferred and have been dashed on the map and the cross-section. Further detail about the bedrock elevation and Quaternary thickness in the West Liberty 7.5' Quadrangle can be found on the accompanying map (IGS Open File Map OFM-25-05), whereas further detail about the Quaternary geology can be found on the Surficial Geologic Map of the West Liberty 7.5' Quadrangle of Muscatine, Cedar, and Johnson counties, Iowa (IGS Open File Map OFM-24-05).

Stratigraphic Column and Legend



Lithostratigraphic Unit Description

Undifferentiated, unconsolidated Quaternary deposits consist of Hudson, Wisconsin, Illinois, and Pre-Illinois episode sediments. This unit consists of glacial diamicton, outwash, colluvium, loess, eolian sands, and alluvium. All unconsolidated sediments overlying Paleozoic bedrock are included in this unit, which only appears in the cross-section and is not depicted on the map.

The **Sweetland Creek Formation** (upper Frasnian) consists predominantly of green-gray to gray calcareous shale and green-gray siltstone. This unit is unconformable with the underlying Little Cedar Formation.

The **Little Cedar Formation** (upper Givetian) is comprised of the Solon and Rapid members (in ascending order) and unconformably overlies strata of the Wapsipinicon Group. The basal Solon Member is condensed in eastern Muscatine County and the fine skeletal packstone (with common to abundant corals and stromatoporoids – locally biostromal) contains multiple hardgrounds. The Rapid Member consists of argillaceous mudstone interstratified with skeletal wackestone/packstone.

The **Pinicon Ridge Formation** (lower to middle Givetian) is comprised of the Kenwood, Spring Grove, and Davenport members (in ascending order). The basal Kenwood Member is an unfossiliferous, argillaceous dolostone with interbeds of gray to green shale (both lithologies contain abundant sand- to silt-sized grains of quartz and chert). This member includes gypsum and anhydrite evaporite units and where these facies are absent brecciated beds may be common. The Spring Grove and Davenport members consist primarily of unfossiliferous limestone and dolostone; the dolostone is interpreted to be a diagenetic facies transition, as such the boundary between the two units is gradational. Strata of the Spring Grove Member are predominantly thinly-laminated, vuggy to porous dolostone (which is petroliferous to varying degrees). A dense 'sublithographic' limestone characterizes the Davenport Member, however, discontinous and local dolostone or thin argillaceous to shaly units may be present locally. In some areas the limestone is interbedded with evaporite facies and well-developed breccia is very common within the Davenport.

The **Otis Formation** (upper Eifelian, lower Givetian) consists of a limestone facies that includes: skeletal, skeletal-intraclastic, and peloidal skeletal packstone/grainstone and mudstone/wackestone (with low diversity faunas); peloidal and peloidal-intraclastic packstone/grainstone; coated-grain to oolitic packstone/grainstone (which may, locally, be oncolitic); laminated mudstone and stromatolitic units; and fenestral ("birdseye") limestone. The Otis Formation unconformably overlies an eroded Silurian surface and it only appears in the cross-section and is not depicted on the map.

The **Gower Formation** (mid-Wenlock to Ludlow?) is comprised of the Anamosa, LeClaire, and Brady members, and the base of this unit is usually marked by a laminated dolostone layer. Strata of the *Anamosa Member* consist of flat-lying, laminated dolostone interbedded with dense unfossiliferous dolostone layers, with occasional low diversity brachiopod- or coral-rich layers and represent inter-reef and inter-bank facies. The *LeClaire Member* is a complex carbonate bank and reef facies that consists of both horizontal and variably dipping mound and inter-mound facies composed of dolomitic mudstone to skeletal wackestone, with occasional skeletal packstones in mound flank facies. The LeClaire Member is laterally equivalent to the Anamosa Member, however the fauna of the LeClaire is very diverse, and vugular porosity is common. The *Brady Member* is a skeletal dolowackestone to dolopackstone, interbedded with dense laminated and nonlaminated dolomudstones and contains an abundant, low-diversity fauna (brachiopods and corals); this facies also forms mounds and is at least in part laterally equivalent to the Anamosa Member. The strata of the Brady Member exhibit flanking and over-stepping relationships with the mound facies of the underlying Palisades-Kepler (P-K) Member (Scotch Grove Formation). Notably, the Gower Formation is truncated by pre-Middle Devonian erosion and it only appears in the cross-section and is not depicted on the map.

Map Symbols

- water wells with depth shown
- geophysical station
- contact, location approximate
- normal fault, location inferred
- cross-section
- hillshade

Lithologies

- coal
- dolostone
- limestone
- lithographic limestone
- sandstone
- sandy limestone
- shale
- siltstone
- unlithified sediments

Lithology & Fossil Symbols

- argillaceous zone
- vugs
- crinoids
- oolitic
- chert
- brachiopods
- corals
- stromatolites
- breccia
- unconformity

Cross-Section Legend

- *W-77248* GeoSam sampling point
- contact
- fault, location inferred

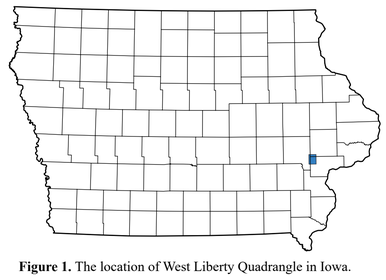


Figure 1. The location of West Liberty Quadrangle in Iowa.

Acknowledgements

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Geology based on work done by A. Bancroft 2022-2025. Digital cartography by P. Kerr. Base map generated using data from the Iowa Geospatial Data Clearinghouse. Map projection and coordinate system based on Universal Transverse Mercator (UTM) Zone 15N, Datum NAD83.

The map and cross-section are based on interpretations of the best available information at the time of mapping. Map interpretations are not a substitute for detailed site-specific studies. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

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1:24,000

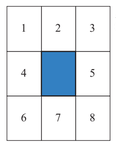
0 0.5 1 2 Miles
0 0.5 1 2 Kilometers

25' contours represent bedrock surface

Road Classification

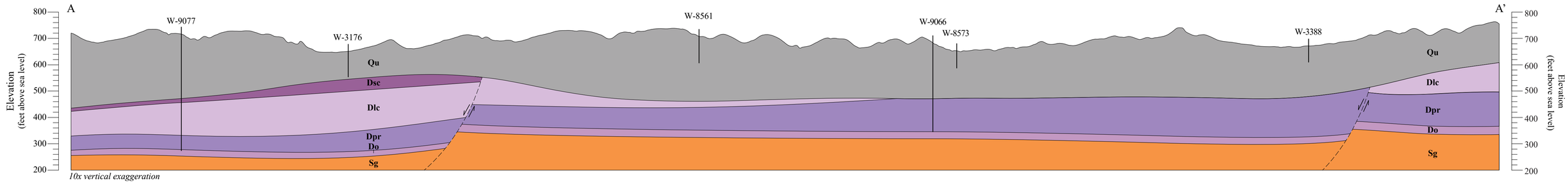
- U.S. Route
- State Route
- Local Road

UTM GRID AND 2025 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET



ADJOINING QUADRANGLES
1 Iowa City East, IA
2 West Branch, IA
3 Rochester, IA
4 West Liberty SW, IA
5 Atalissa, IA
6 Lone Tree, IA
7 Nichols, IA
8 Muscatine NW, IA

Geologic Cross-Section A-A'



10x vertical exaggeration